

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
23 October 2003 (23.10.2003)

PCT

(10) International Publication Number
WO 03/088615 A2

(51) International Patent Classification⁷: H04L 29/06

(21) International Application Number: PCT/JP03/04898

(22) International Filing Date: 17 April 2003 (17.04.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2002-115861 18 April 2002 (18.04.2002) JP
2003-108846 14 April 2003 (14.04.2003) JP

(71) Applicant (for all designated States except US): MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD. [JP/JP]; 1006, Oaza Kadoma, Kadoma-shi, Osaka 571-8501 (JP).

(72) Inventors; and

(75) Inventors/Applicants (for US only): FUNABIKI, Makoto [JP/JP]; 3-33-17, Sugao, Miyamae-ku, Kawasaki-shi, Kanagawa 216-0015 (JP). IKEDA, Shinkichi [JP/JP]; 11-5-105, Omaru, Tsuzuki-ku, Yokohama-shi, Kanagawa 224-0061 (JP). MATSUMOTO, Taisuke [JP/JP]; 2-12-14-705, Kitasaiwai, Nishi-ku,

Yokohama-shi, Kanagawa 220-0004 (JP). KIMURA, Yasunari [JP/JP]; 34-19-G309, Chigusadai, Aoba-ku, Yokohama-shi, Kanagawa 227-0051 (JP). KOBAYASHI, Hirokazu [JP/JP]; 224-1-102, Gorikida, Asao-ku, Kawasaki-shi, Kanagawa 215-0025 (JP).

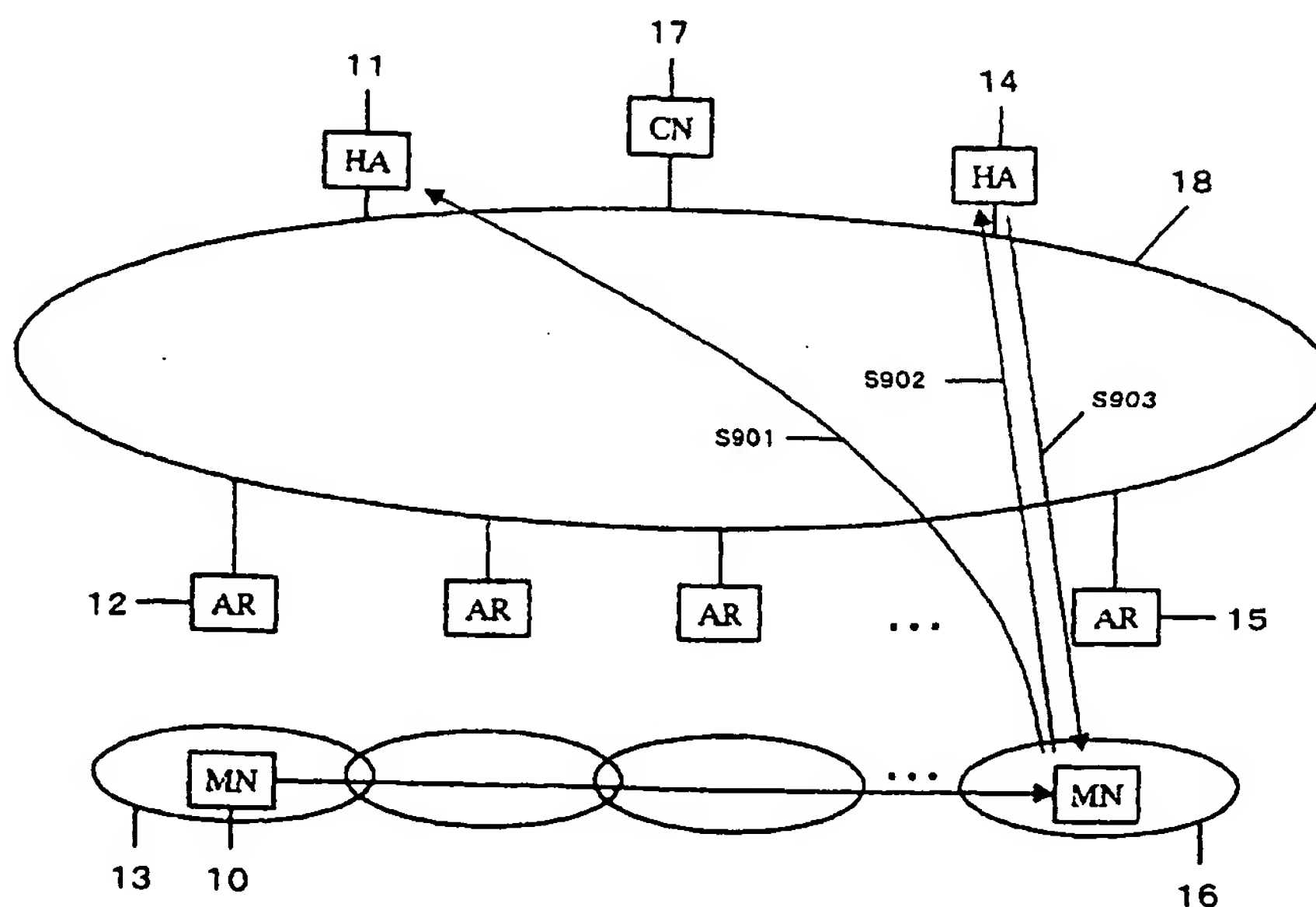
(74) Agents: IWAHASHI, Fumio et al.; c/o Matsushita Electric Industrial Co., Ltd., 1006, Oaza Kadoma, Kadoma-shi, Osaka 571-8501 (JP).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,

[Continued on next page]

(54) Title: MOBILE NODE AND METHOD FOR MOBILE COMMUNICATIONS



(57) Abstract: In a mobile communication system supported with IP version 6, a mobile node (10) measures at least one of a hop number or communication delay time to a belonging home agent (11). When the result of measurement is equal to or greater than a predetermined value, registration deletion is requested to the belonging home agent (11) while registration is requested to a new home agent (14). The belonging home agent (11) deletes the registration of mobile node (10), and the new home agent (14) registers the mobile node. This can reduce the load on an IP network (18) and decrease data delay.

WO 03/088615 A2

home agent; a home agent information notifying section for notifying at least one of a mobile node, access router and home agent in connection to a network of the home agent information selected from the home agent information storing section.

5 Due to this, because home agent information storing server is storing the information of neighboring home agents, the other communication apparatus is allowed to readily get home agent information.

10 Also, in a home agent information storing server of the invention, the home agent information storing section further holds at least one piece of information of current unoccupied resource and load of the managing home agent.

15 Due to this, the other communication apparatus is allowed to readily get the information about current unoccupied resource and load.

 Also, a home agent information storing server of the invention further comprises a home agent information acquiring section for receiving the information from the managing home agent and updating the home agent information storing section.

20 Due to this, because the home agent sends information to the home agent information storing server, it is easy to get home agent information.

 Also, a home agent of the information further comprises a home agent information acquiring section for acquiring the home agent information from the home agent information storing server according to the invention.

25

Due to this, because the home agent gets home agent information from the home agent information storing server, the home agent can be simplified in configuration.

Also, a home agent of the invention is characterized to send
5 information of own load and unoccupied resource to the home agent information storing server according to the invention.

Due to this, the home agent information storing server is allowed to readily get home agent information.

Also, an access router of the invention further comprises
10 a home agent information acquiring section for getting the home agent information from the home agent information storing server of the invention.

Due to this, because the access router gets home agent information from the home agent information storing server, the
15 access router can be simplified in configuration.

Also, in a mobile node of the invention, the home agent information acquiring section gets the home agent information from the home agent information storing server of the invention.

Due to this, because the mobile node gets home agent
20 information from the home agent information storing server, the mobile node can be simplified in configuration.

Also, the home agent information acquiring section in a mobile node of the invention is notified of information for the home agent from the home agent of the invention.

25 Due to this, the home agent information about a new home agent can be readily known.

Also, the home agent selecting section of a mobile node of the invention selects, preferentially, a home agent satisfying at least any of conditions of greatest unoccupied resource, minimum load, least hop number and shortest communication delay
5 time.

Due to this, the mobile node is allowed to select a home agent best suited for the condition.

A method for mobile communications according to the invention comprises: a step of measuring at least any one of a
10 hop number and communication delay time to a belonging home agent by a mobile node; a step of requesting a belonging home agent to delete registration and a new home agent to make registration, when a result of measurement becomes equal to or greater than a predetermined value; a step of deleting a registration of the
15 mobile node by the belonging home agent; and a step of registering the mobile node by the new home agent.

Also, in a method for mobile communications of the invention, the new home agent is to be selected preferentially a home agent satisfying at least any of conditions of greatest unoccupied
20 resource, minimum load, least hop number and shortest communication delay time.

Also, in a method for mobile communications of the invention, the new home agent is notified from a home agent information managing server for managing information about home agents to the
25 mobile node.

As described above, according to the invention, even where

the mobile node and the home agents are distant in space, network load can be relieved and handover of mobile node is smoothly carried out. Also, it is possible to swiftly eliminate the resource deficiency of home agent and change the control range.

5

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram showing a configuration of a mobile communication system and a packet path in a first embodiment of the present invention.

10 Fig. 2 is a diagram of a packet path in the first embodiment of the invention.

Fig. 3 is a configuration diagram of a mobile node in the first embodiment of the invention.

15 Fig. 4 is a flowchart showing a mobile node operation in the first embodiment of the invention.

Fig. 5 is a flowchart showing a mobile node operation in the first embodiment of the invention.

Fig. 6 is a configuration diagram of a mobile node in the first embodiment of the invention.

20 Fig. 7 is a flowchart showing a mobile node operation in the first embodiment of the invention.

Fig. 8 is a configuration diagram of an access router in the first embodiment of the invention.

25 Fig. 9A is a figure showing a home agent information management table in the first embodiment of the invention.

Fig. 9B is a figure showing a home agent information

management table in the first embodiment of the invention.

Fig. 10 is a configuration diagram of a home agent in the first embodiment of the invention.

Fig. 11 is a flowchart showing a home agent operation in
5 the first embodiment of the invention.

Fig. 12 is a diagram showing a packet path in the first embodiment of the invention.

Fig. 13 is a configuration diagram of a mobile communication system in a second embodiment of the present invention.

10 Fig. 14 is a diagram showing a packet path in a second embodiment of the invention.

Fig. 15A is a flowchart showing a home agent information storing server operation in the second embodiment of the invention.

15 Fig. 15B is a flowchart showing a mobile node operation, an access router operation, and a home agent operation in the second embodiment of the invention.

Fig. 16 is a configuration diagram of a home agent information storing server in the second embodiment of the
20 invention.

Fig. 17 is a diagram showing a configuration of a mobile communication system and a packet path in a third embodiment of the present invention.

Fig. 18 is a flowchart showing a mobile node operation in
25 the third embodiment of the invention.

Fig. 19 is a flowchart showing a mobile node operation in

the third embodiment of the invention.

Fig. 20 is a configuration diagram of a home agent in the third embodiment of the present invention.

Fig. 21 is a flowchart showing a home agent operation in
5 the third embodiment of the invention.

Fig. 22 is a flowchart showing a home agent operation in the second embodiment of the invention.

Fig. 23 is a diagram showing a prefix table in the third embodiment of the invention.

10 Fig. 24 is a diagram showing a configuration of a mobile communication system and a packet path in a fourth embodiment of the invention.

Fig. 25 is a figure showing a registration/deregistration request message in the first embodiment of the invention.

15 Fig. 26 is a figure showing a registration answer message in the first embodiment of the invention.

Fig. 27 is a figure showing a binding cache information request message in the first embodiment of the invention.

20 Fig. 28 is a figure showing a binding cache information notifying message in the first embodiment of the invention.

Fig. 29 is a figure showing a home agent information request message other than an access router in the invention.

Fig. 30 is a figure showing a home agent information notifying message other than an access router in the invention.

25 Fig. 31 is a figure showing a home agent information request message to an access router in the invention.

Fig. 32 is a figure showing a home agent information notifying message from an access router in the invention.

Fig. 33 is a configuration diagram of a conventional radio station.

5

BEST MODE FOR CARRYING OUT THE INVENTION

The present invention will now be explained in conjunction with the drawings.

(Embodiment 1)

10 Fig. 1 is a configuration diagram of a mobile communication system in embodiment 1 of the present invention.

In Fig. 1, a mobile node 10 is a mobile communication terminal, and home agents 11, 14 are routers to which the mobile node 10 can be allowed to register the current care-of addresses. 15 Access routers 12, 15 are routers accessible to the Internet to which the mobile node 10 can be allowed to access. Control ranges 13, 16 are respective ranges in which the access router 12, 15 can have communications. A correspondent node 17 is a communication terminal for communications with the mobile node 20 10, while an IP network 18 is an electric communication line over which an IP protocol is supported.

With the configuration of Fig. 1, the operation is explained in the below.

First, the mobile node 10 has an access to the access router 25 12 to get a care-of address, and then sends the home agent 11 a binding update message requesting a registration(step S301).

Next, the mobile node 10 receives a binding acknowledgement message 4050 from the home agent 11 (step S1504) and makes sure of whether a home agent change instruction flag 4032 to be set on the home agent 11 has been set or not (step S1505). Herein,
5 the format of binding acknowledgement message 4050 is shown in Fig. 26. Also, the home agent change instruction flag (C) 4032 is to instruct the mobile node to change the home agent. Incidentally, Step S1504 corresponds to Step S304 of Fig. 1.

When this home agent change instruction flag 4032 has not
10 been set, i.e. when a binding acknowledgement message 4050 representative of a successful registration is received, the home agent selecting section 1104 carries out a binding acknowledgement process, such as updating a binding update list (step S1508). Thereafter, the process returns to the step S1501.

15 On the other hand, when receiving a binding acknowledgement message 4050 in which the home agent change instruction flag 4032 has been set, the home agent selecting section 1104 carries out the following home agent selecting process (step S1506).

This selecting process is explained in the below.

20 First, the home agent information acquiring section 1107, in order to acquire the information of a changed-to candidate home agent, sends the access router 15 a home agent information request message (step S305) and waits for a home agent information notifying message as a reply thereto. Fig. 31 shows a format of
25 home agent information request message 4550. This home agent information request message 4550 is an addition of a flag (H) 4501

representative of a request for home agent information to the conventional router solicitation message.

Next, the home agent information acquiring section 1107, after receiving a home agent information notifying message 4650 shown in Fig. 32 from the access router 15 (step S306), holds the content thereof in the home agent information storing section 1105.

Fig. 32 shows a format of home agent information notifying message 4650. As shown in Fig. 30, the home agent information notifying message 4650 is a router advertisement message 4610 which is added with a home agent information option 4040 that includes a home agent information. The home agent information option 4040 contains home agent addresses, resource information, load information and so on.

Meanwhile, in the case that a home agent address and hop number or a communication delay time is included in the home agent information notifying message 4650, the home agent selecting section 1104 decides as a changed-to agent a home agent minimal in hop number or communication delay time of among those included in the message.

Meanwhile, the home agent selecting section 1104 may set a predetermined threshold in a Hop Limit field of an ICMP echo request message so that, when the ICMP echo reply message is sent back, the home agent as a destination can be determined as a changed-to agent.

Incidentally, the home agent selecting section 1104 may

hold, by manual setting, a home agent address of changed-to candidate in the home agent information management table 1105.

Meanwhile, in the case only a home agent address is included in the message, the hop-number measuring section 1106 sends a
5 packet for the hop-number measuring section 1106 to measure a hop number to the address shown in the message. For example, this packet is an ICMP echo request message. As a reply thereto, waited is an ICMP echo reply message from the home agent. IPv6 Base Header 3900 as shown in Fig. 25 is attached to these messages.
10 The hop-number measurement is performed using the Hop Limit field 3901 in this header. Namely the hop-number measuring section 1106 receives the ICMP echo reply message and makes reference to a field (Hop Limit field 3901) representative of a hop number in a received-message IP header, to determine a difference from an
15 initial value set at the hop-number measuring section 1106 thereby measuring a hop number. Otherwise, hop-number measurement is made by using a traceroute command.

Meanwhile, the communication delay time measuring section 1108 measures a communication delay time. This measurement is
20 by that the timer which is not shown in Fig. 3 measures a time of from sending an ICMP echo request message to receiving the ICMP echo reply message.

The home agent selecting section 1104, in case both or any one of the measured hop number and communication delay time is
25 equal to or smaller than a predetermined hop number or communication delay time, determines a change to that home agent.

Also, the home agent selecting section 1104, unless both or any one of the hop number and communication delay time for all the addresses included in a home agent information option 4040 of the home agent information notifying message 4650 is equal to or less
5 than a predetermined hop number or communication delay time, determines as a changed-to agent a home agent smallest in the hop number or communication delay time including the current home agent or otherwise does not make a change of home agent. Incidentally, the home agent selecting section 1104, in case only
10 one home agent address is included in the home agent information notifying message 4650, determines that home agent as a changed-to agent.

The above is the home agent selection process (step S1506).

Next, the home agent selecting section 1104, after
15 selecting a changed-to home agent 14, carries out the below home agent change process (step S1507).

First, the home agent selecting section 1104 sends, to the home agent 14 determined as a changed-to agent, ICMP mobile prefix request message to request a home prefix which is subnetwork
20 prefix of a home link, thus waiting for a ICMP mobile prefix advertising message.

Next, the home agent selecting section 1104, after receiving a home prefix notifying message, generates a home address.

25 Thereafter, as shown in Fig. 2, the home agent selecting section 1104 sends the home agent 11 a binding update message 3950

(step S901) that a formerly-used home address is set to the home address destination option and a Lifetime field 3992 is set at '0', and further sends the changed-to home agent 14 a binding update message 3950 of home registration (step S902).

5 The above is the home agent changing process (step S1507).
Thereafter, the process returns to step S1501.

 This embodiment shows the case that the home agent measured a hop number and communication delay time, to notify a change of home agent to the mobile node 10. However, the measurement of
10 a hop number and communication delay time can be on the mobile node 10. The operation in such a case is explained by the use of the flowchart of Fig. 5.

 The difference from the operation shown in Fig. 4 lies in that, in step S2605 and step 2606, the mobile node 10 does not
15 receive a notification of a change instruction of home agent from the home agent 11 but measures, when receiving a binding acknowledgement message 4050, a hop number and communication delay time thereby determining whether to change the home agent or not. Namely, the home agent selecting section 1104, when
20 receiving a binding acknowledgement message 4050 (step S2604), instructs the hop-number measuring section 1106 and communication delay time measuring section 1108 to make a measurement of both or any one.

 The hop-number measuring section 1106 measures a hop number
25 to the home agent 11 (step S2605) while the communication delay time measuring section 1108 measures a communication delay time

(step S2606). From a measured hop number and communication delay time, the home agent selecting section 1104 makes a comparison with a predetermined value (step S2607). Otherwise, the hop-number selecting section 1106 and communication delay time measuring section 1108 compare these with respective predetermined values, to output a result thereof to the home agent selecting section 1104. Incidentally, selecting a home agent using a hop number and communication delay time is possible by the following method.

10 Next, the home agent selecting section 1104 compares the predetermined value #3 as the hop- number and communication delay time which were measured like the home agent (S2607). The subsequent processing step S208 or subsequent step S2610 is the same as above-mentioned step S1506 or above-mentioned step S1508.

15 Fig. 6 is a configuration diagram of the mobile node 10 in this case. Meanwhile, Fig. 7 is a flowchart showing the operation of mobile node 10.

 In Fig. 6, a hop-number/communication-delay-time measuring section 2508 measures a hop number and communication delay time
20 (step S2705).

 The measurement results can be changed in their applications depending upon a communication content. For example, in case the communication content between the mobile node 10 and the correspondent node 17 has a real-time nature such as
25 voice communication, the home agent is changed by communication time measurement. If not so, home agent change can be by

hop-number measurement. Otherwise, by computing a value taking account of both of communication delay time and hop number, the home agent is changed depending upon a magnitude thereof. For example, used is a determination value A to be computed in Equation (1).

$$A = \alpha \times (\text{communication delay time}) + \beta \times (\text{hop number}) \quad (1)$$

where α , β is a communication delay time and a weight for hop number. By adjusting these, it can be changed which one is to be emphasized of communication delay time and hop number.

Meanwhile, in the case there are a plurality of correspondent nodes, measuring a communication delay time may be only for the correspondent node in real-time communication with the mobile node 10, thereby changing the home agent. Otherwise, by comparing the sum of the values determined in the above Equation (1) for each correspondent node, the home agent may be changed.

As described above, because the mobile node measures a hop number or communication delay time, there is no need to measure a hop number or communication delay time on every mobile node the home agent belongs. Consequently, the load on the home agent can be relieved, enabling load distribution to the mobile nodes.

Incidentally, the mobile node 10 can use a dynamic DNS server (hereinafter referred to as "DNS") in communications with the correspondent node 17. In such a case, the home agent selecting section 1104 sends the changed-to home agent 14 a binding update message 3950 and registers a new home address to the DNS. Thereafter, the correspondent node 17 can make an

15 makes measurement in advance.

In the case that the access router 15, in advance, measures a hop number to the home agent, the hop-number measuring section 1205 sends the home agent an ICMP echo request message, to wait
5 for an ICMP echo reply message from the home agent. The hop-number measuring section 1205, after receiving an ICMP echo reply message, makes reference to the header in the message, and measures a hop number by using a similar method to that of the mobile node. The communication delay time is determined by
10 measuring a time of from sending an ICMP echo request message to receiving an ICMP echo reply message.

Next, explanation is made on the operation at a time that the access router 15 receives a home agent information request message 4550 from the mobile node 10 by using Fig. 1.

15 First, the home agent information notifying section 1204, after receiving a home agent information request message 4550 from the mobile node 10 (step S305), makes reference to the home agent information management table 3510 held by itself and generates a home agent information notifying message 4650, to send it to
20 the mobile node 10. The home agent information notifying message 4650, including at least one home agent address, may include a hop number of between the access router and the home agent.

Incidentally, as shown in this embodiment, the home agent
25 information option 4040 may be included in a router advertisement message notifying the prefix information about the access router,

or can configure a packet by itself.

Incidentally, in the notification method of home agent information, a home agent information notifying message 4650 may be notified as a reply to a home agent information request message 5 4550 from the mobile node 10 to the access router 15. Otherwise, the access router 15 may notify, by broadcast or multicast, a home agent information notifying message 4650 to which the access router 15 periodically notifies home agent information, to the mobile nodes 10 existing within the control range 16 of the access 10 router 15.

Fig. 10 is a diagram showing a configuration of the home agent. A network interface 1300 is for connection to the IP network. A data link interface 1301 is to exchange packets with the data link layer. An IP processing section 1302 is to carry 15 out an IP process including mobile IP. A home agent information storing section 1303 is stored with the information about neighboring home agents. A home agent information notifying section 1304 is to notify home agent information to the mobile node 10. A hop-number measuring section 1305 is to measure a hop 20 number to a mobile node 10. A home agent information acquiring section 1306 is to get home agent information. A communication delay time measuring section 1307 is to measure a communication delay time to a mobile node 10.

Explanation is made on the home agent operation when a 25 mobile node 10 requests a registration to the home agent, by using a flowchart of Fig. 1 and Fig. 11.

The network interface 1300, when receiving a binding update message 3950 from a mobile node 10 (step S1601), makes a notification to the hop-number measuring section 1305 and communication delay time measuring section 1307. Incidentally,
5 Step S1601 corresponds to Step S301 and S303 of Fig. 1.

Next, the hop-number measuring section 1305 measures a hop number of the received message (step S1602), while the communication delay time measuring section 1307 measure a communication delay time (step S1603).

10 The hop-number measuring section 1305 makes reference to a field (hop limit field 3901) representing a hop number in an IP header of the received binding update message 3950 and determines a difference from an initial value set in the mobile node 10, thereby determining a hop number. The initial value of
15 hop limit field 3901 is set to a value common among all the binding update messages 3950. Otherwise, an initial hop limit option 3930 representative of an initial value is added into the binding update message 3950 as showing in Fig. 25. The mobile node 10 sets the same value as the initial value set in the hop limit field
20 3901, and the hop-number measuring section 1305 makes reference to that field. Otherwise, measurement is possible by the use of a traceroute command.

The communication delay time measuring section 1307 sends an ICMP echo request message to the mobile node 10. The
25 communication delay time measuring section 1307, after receiving the ICMP echo request message from the mobile node 10, measures

and sends the mobile node 10 a home agent information notifying message describing the selected home agent (step S802).

The subsequent process is similar to that of the first embodiment.

5 Incidentally, when the mobile node 10 decides a change of home agent, home agent information can be requested to the access router 15. In this case, realization is possible by that the access router 15 sends the home agent information storing server 19 a home agent request message and the home agent information
10 obtained from the home agent information storing server 19 is notified to the mobile node 10.

Now, explanation is made on the operation of each apparatus.

The configuration of the mobile node 10 is similar to that of the first embodiment.

15 Meanwhile, the operation of the mobile node 10 is different from that of the first embodiment in that home agent information is acquired from a home agent information storing server 19. This is explained by using a flowchart of Fig. 15B.

First, the home agent information acquiring section 1107
20 generates a home agent information request message and sends it to the home agent information storing server 19 (step S3404). Fig. 29 shows a format of home agent information request message 4300. Incidentally, step S3404 corresponds to Step S801 of Fig. 14.

Then, the home agent information acquiring section 1107
25 receives the home agent information notifying message from the home agent information storing server 19 (step S3405) and stores

an address of home agent to the home agent information storing section 1105. Fig. 30 shows a format of home agent information notifying message 4450. The home agent information notifying message 4450 is added of a home agent information option 4040 as shown in Fig. 30. The home agent information option 4040 includes IP address, resource information, and load information and so on of the home agent. Incidentally, step S3405 corresponds to Step S802 of Fig. 14.

Next, the home agent selecting section 1104 selects a home agent (step S3406). This process, however, is similar to that of the first embodiment.

Now, the operation of the access router 15 is explained. Incidentally, the configuration of the access router 15 is similar to that of the first embodiment.

The operation of the access router 15 is different from that of the first embodiment in that home agent information is acquired from the home agent information storing server 19.

Fig. 15B is a flowchart which shows operation of an access router.

First, the home agent information acquiring section 1206 generates a home agent information request message 4300 and sends it to the home agent information storing server 19 (step S3404). Incidentally, step S3404 corresponds to Step S701 of Fig. 13.

Then, the home agent information acquiring section 1206 receives the home agent information notifying message 4450 from the home agent information storing server 19 (step S3405), and

23. A home agent according to claim 22, characterized to send information of own load and unoccupied resource to the home agent information storing server:

a home agent information storing section for holding home agent information including an address of a managing home agent;
5 and

a home agent information notifying section for notifying any one of a mobile node, access router and home agent in connection to a network of the home agent information selected from the home agent information storing section;
10

wherein the home agent information storing section further holds any one piece of information of current unoccupied resource and load of the managing home agent.

24. An access router according to claim 16, further comprising a home agent information acquiring section for getting the home agent information from the home agent information storing server:
15

a home agent information storing section for holding home agent information including an address of a managing home agent;
20 and

a home agent information notifying section for notifying any one of a mobile node, access router and home agent in connection to a network of the home agent information selected from the home agent information storing section;

25 wherein the home agent information storing section further holds any one piece of information of current unoccupied resource

and load of the managing home agent.

25. A mobile node according to claim 1, wherein the home agent information acquiring section gets the home agent information from the home agent information storing server:

5 a home agent information storing section for holding home agent information including an address of a managing home agent; and

 a home agent information notifying section for notifying any one of a mobile node, access router and home agent in connection
10 to a network of the home agent information selected from the home agent information storing section;

 wherein the home agent information storing section further holds any one piece of information of current unoccupied resource and load of the managing home agent.

15 26. A mobile node according to claim 1, wherein the home agent information acquiring section gets information about a home agent notified from the home agent comprising:

 a home agent information notifying section for answering a registration refusal in a case that, when receiving a
20 registration request from a mobile node, the home agent is deficient in unoccupied resource; and

 a home agent information storing section for storing home agent information including an address and current resource information of another home agent;

25 wherein the home agent information notifying section answers the registration refusal and selects a home agent suited

for a predetermined condition from the home agent information storing section to thereby answer home agent information of the selected home agent.

27. A mobile node according to claim 26, wherein the home agent selecting section selects, preferentially, a home agent satisfying at least any of conditions of greatest unoccupied resource, minimum load, least hop number and shortest communication delay time.

28. A method for mobile communications comprising:

10 a step of measuring at least any one of a hop number and communication delay time to a belonging home agent by a mobile node;

a step of requesting a belonging home agent to delete registration and a new home agent to make registration, when a
15 result of measurement becomes equal to or greater than a predetermined value;

a step of deleting a registration of the mobile node by the belonging home agent; and

a step of registering the mobile node by the new home agent.

20 29. A method for mobile communications according to claim 28, wherein as the new home agent is selected preferentially a home agent satisfying at least any of conditions of greatest unoccupied resource, minimum load, least hop number and shortest communication delay time.

25 30. A method for mobile communications according to claim 29, wherein the new home agent is notified from a home agent

information managing server for managing information about home agents to the mobile node.

FIG. 1

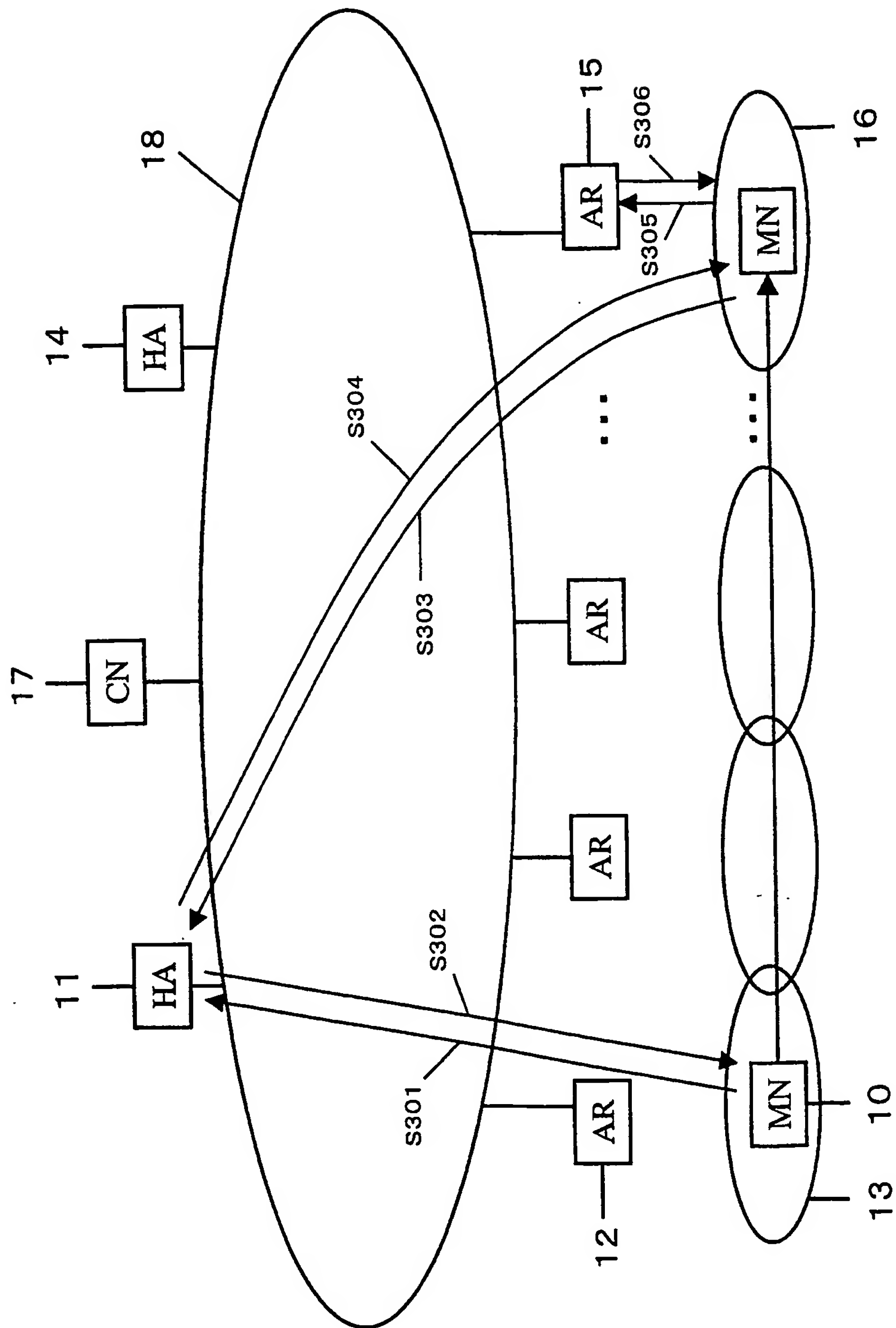


FIG. 2

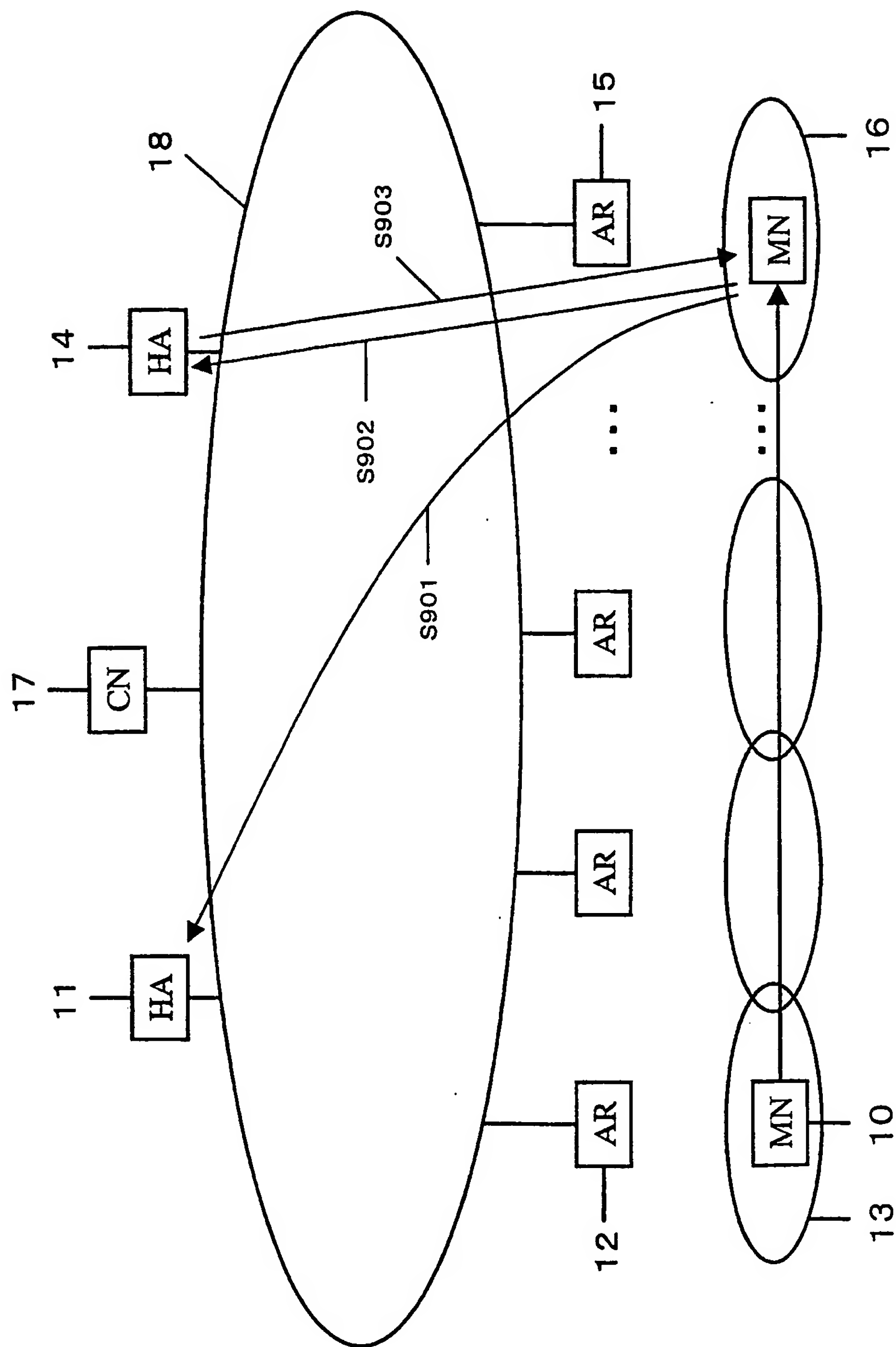
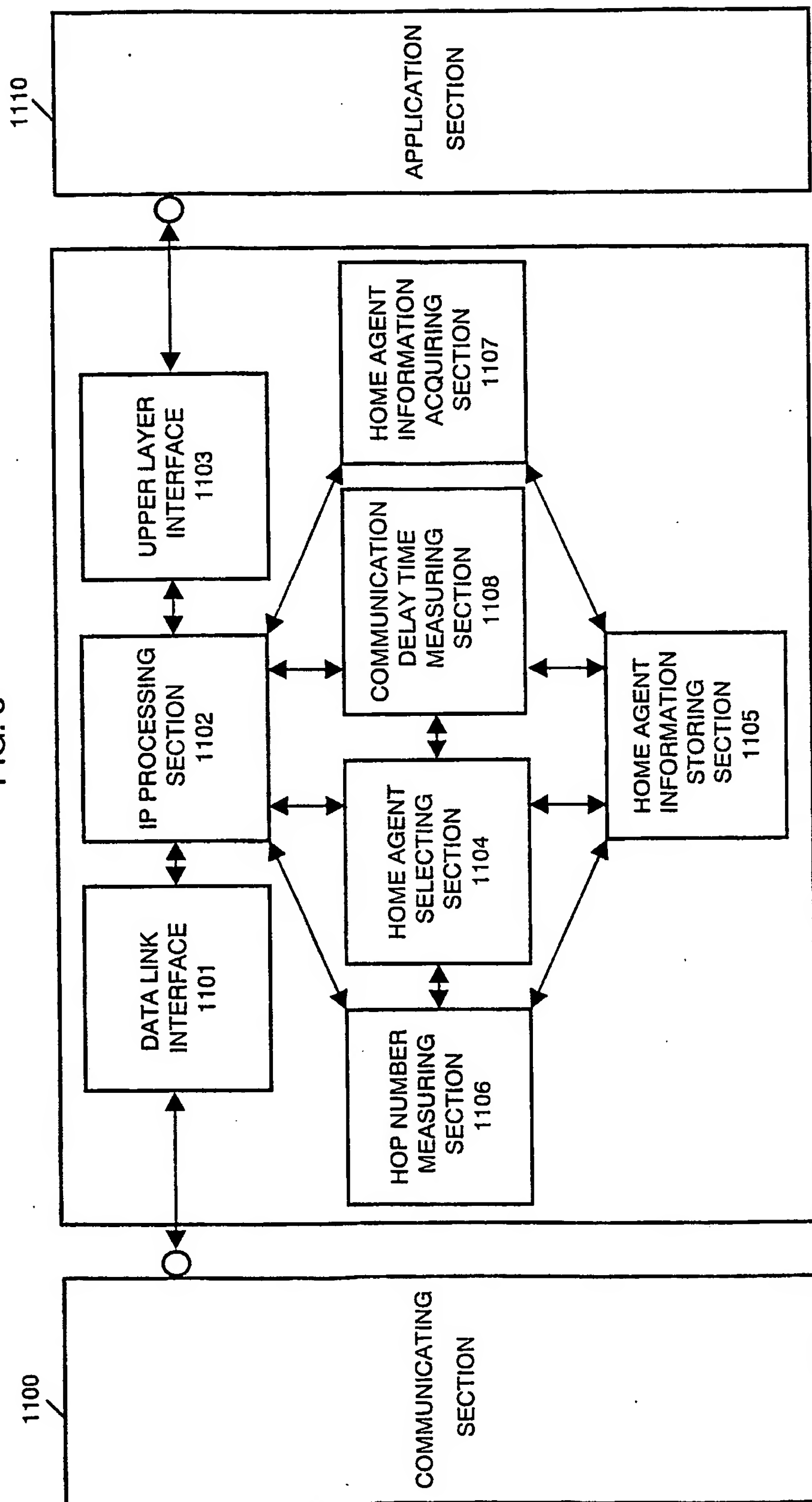
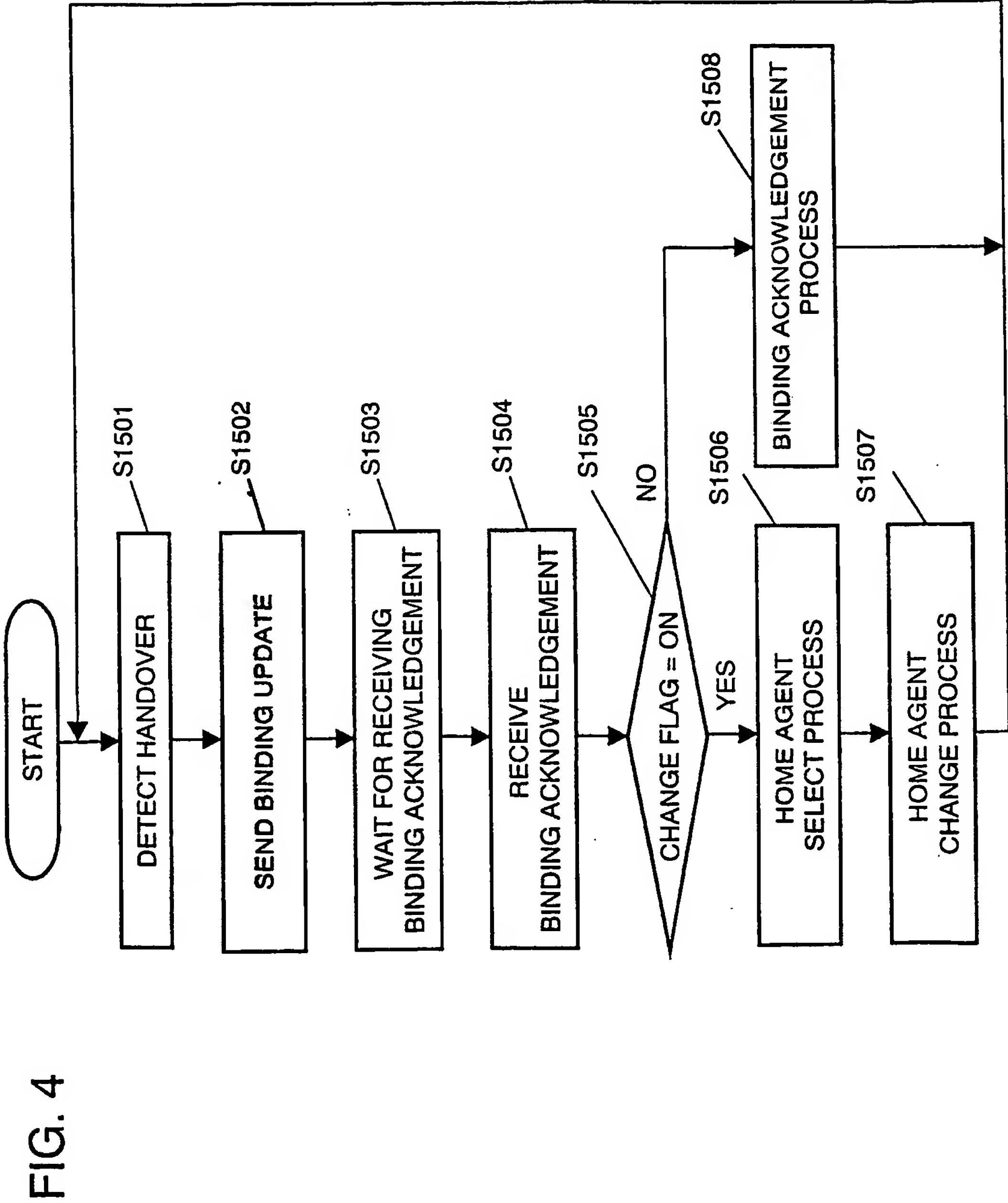


FIG. 3





5/35

FIG. 5

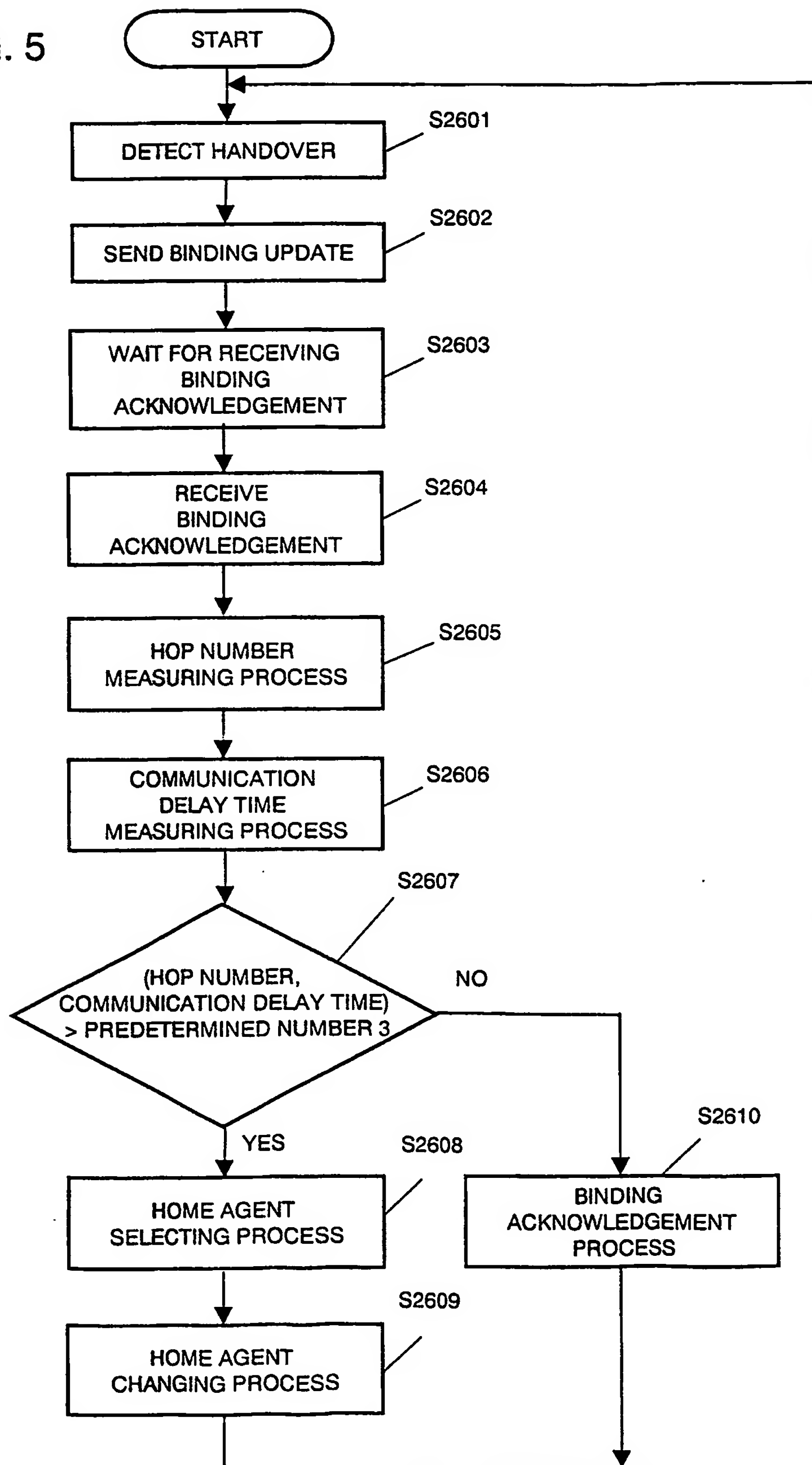


FIG. 6

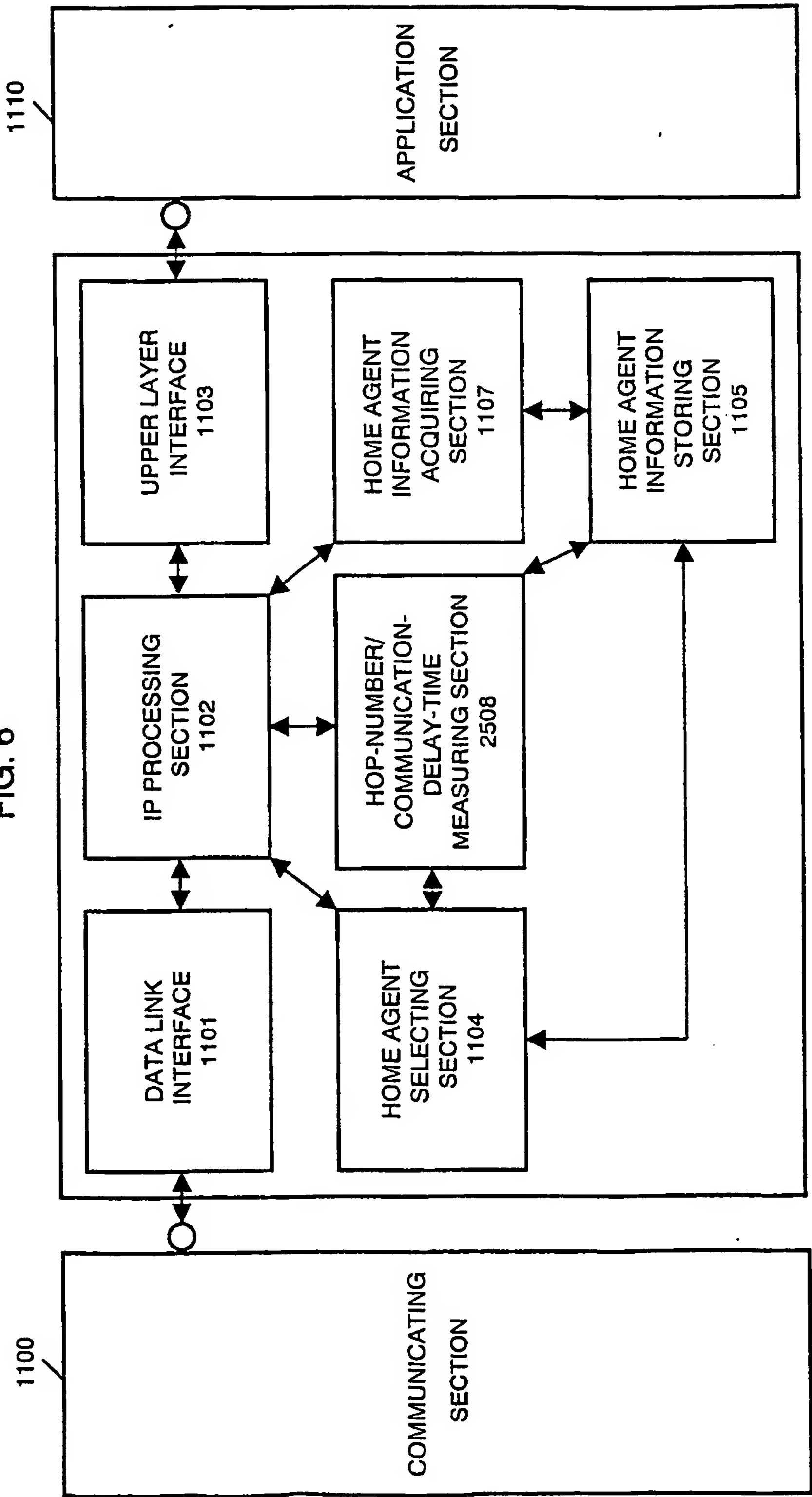


FIG. 7

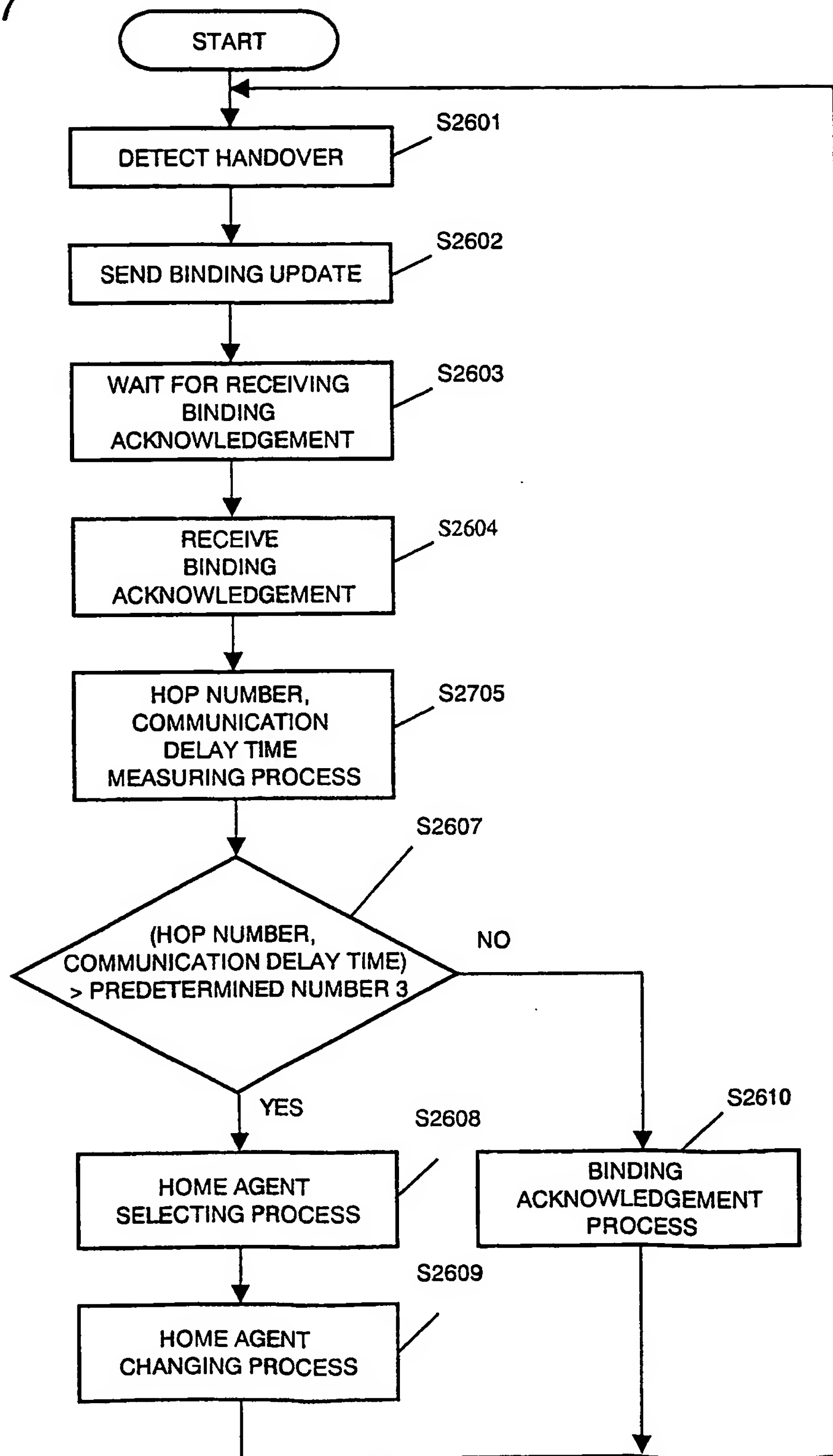
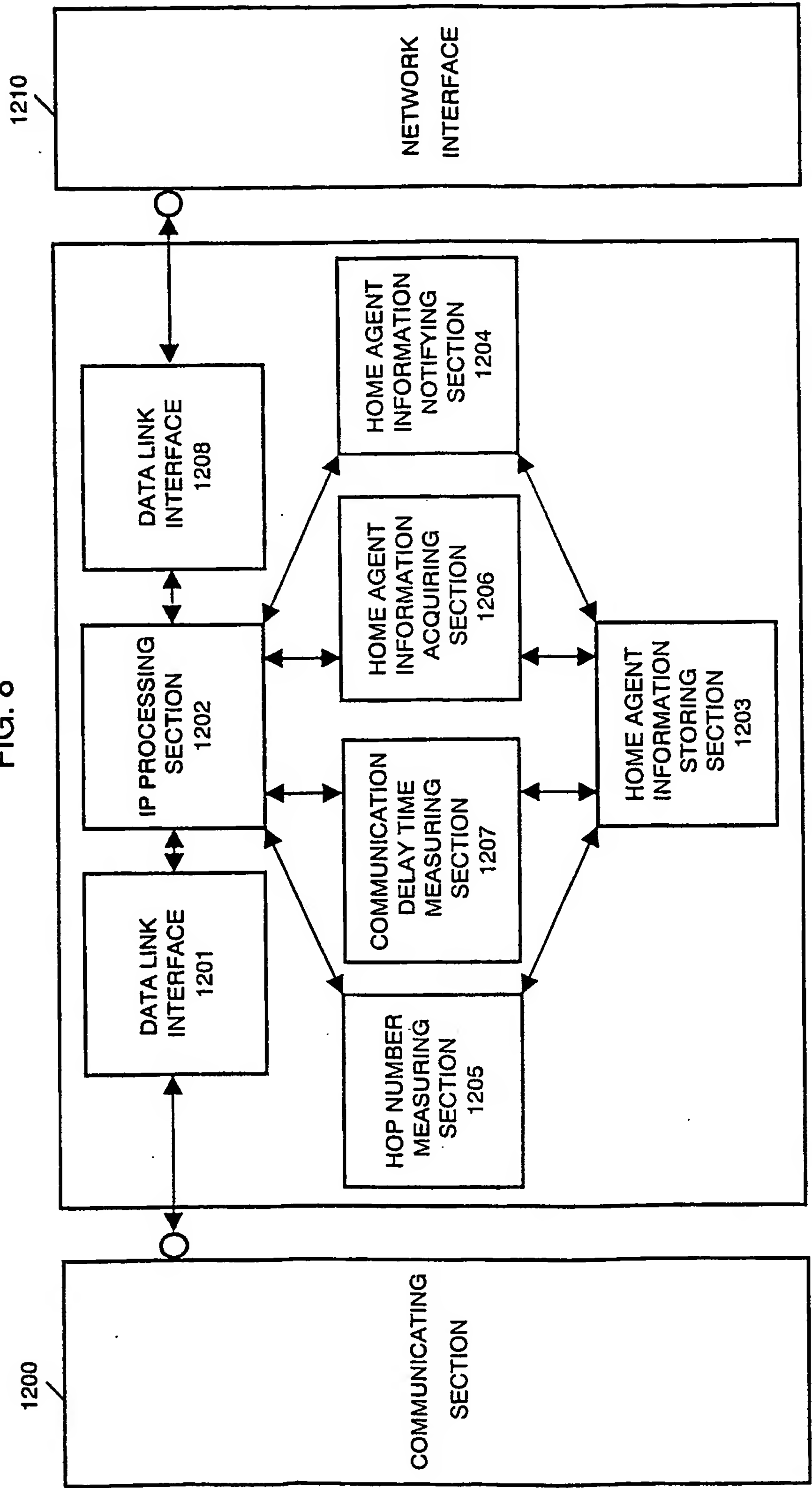


FIG. 8



3500

3501 Home Agent	3502 Prefixes	3503 Access Routers	3504 Information
1:2:2:3:4:5:6:7	1:2:3:0::0/48	AR1~16	Load = High Resource = OK
	1:2:4:0::0/48	AR17~32	
1:2:5:6:7:8:9:1	1:2:5:0::0/48	AR33~38	Resource = Empty
⋮	⋮	⋮	⋮

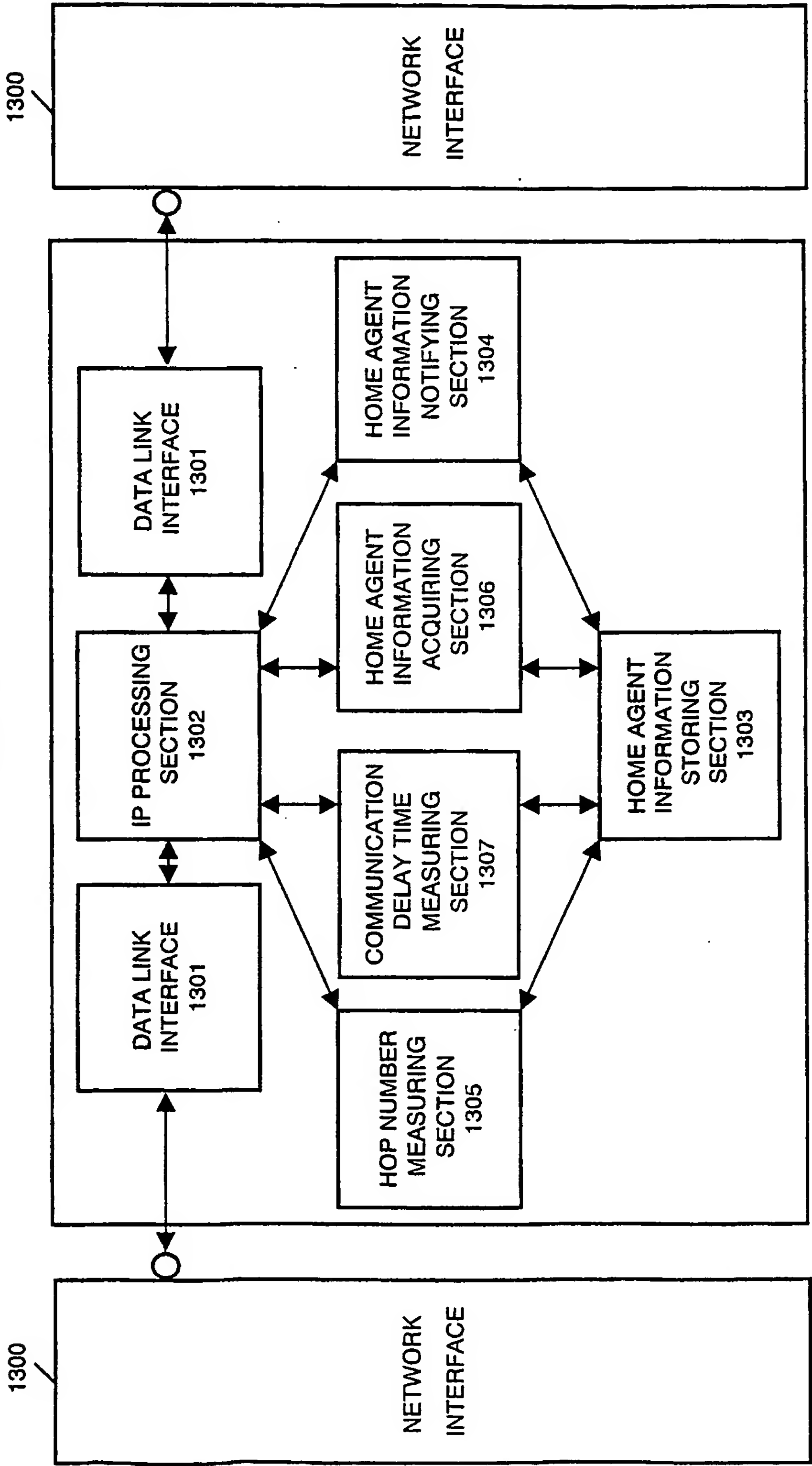
FIG. 9A

3510

3501 Home Agent	3504 Information	3505 Hop	3507 Delay
1:2:2:3:4:5:6:7	Load = High Resource = OK	13	100msec
1:2:5:6:7:8:9:1	Resource = Empty	12	90msec
⋮	⋮	⋮	⋮

FIG. 9B

FIG. 10



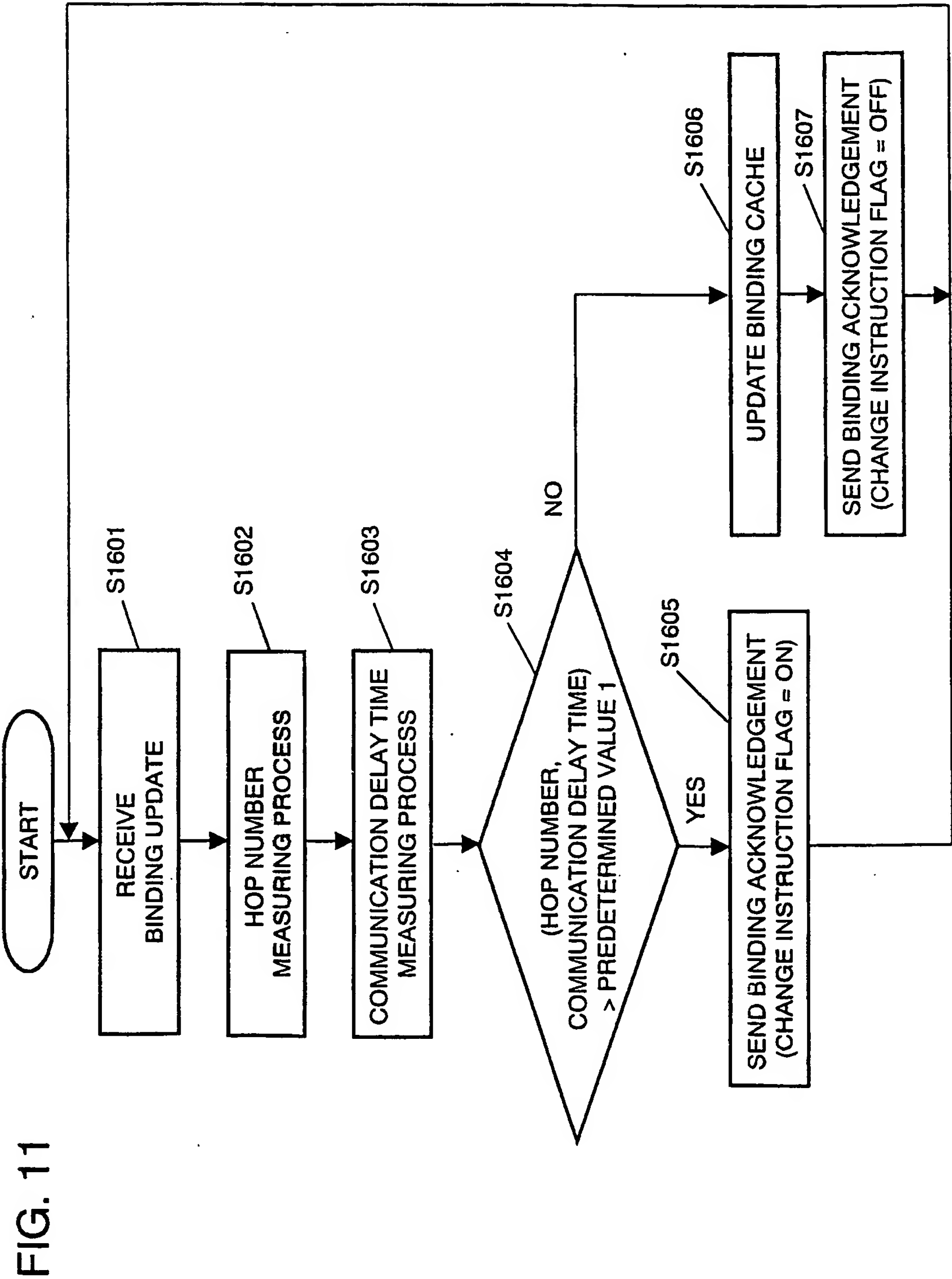


FIG. 12

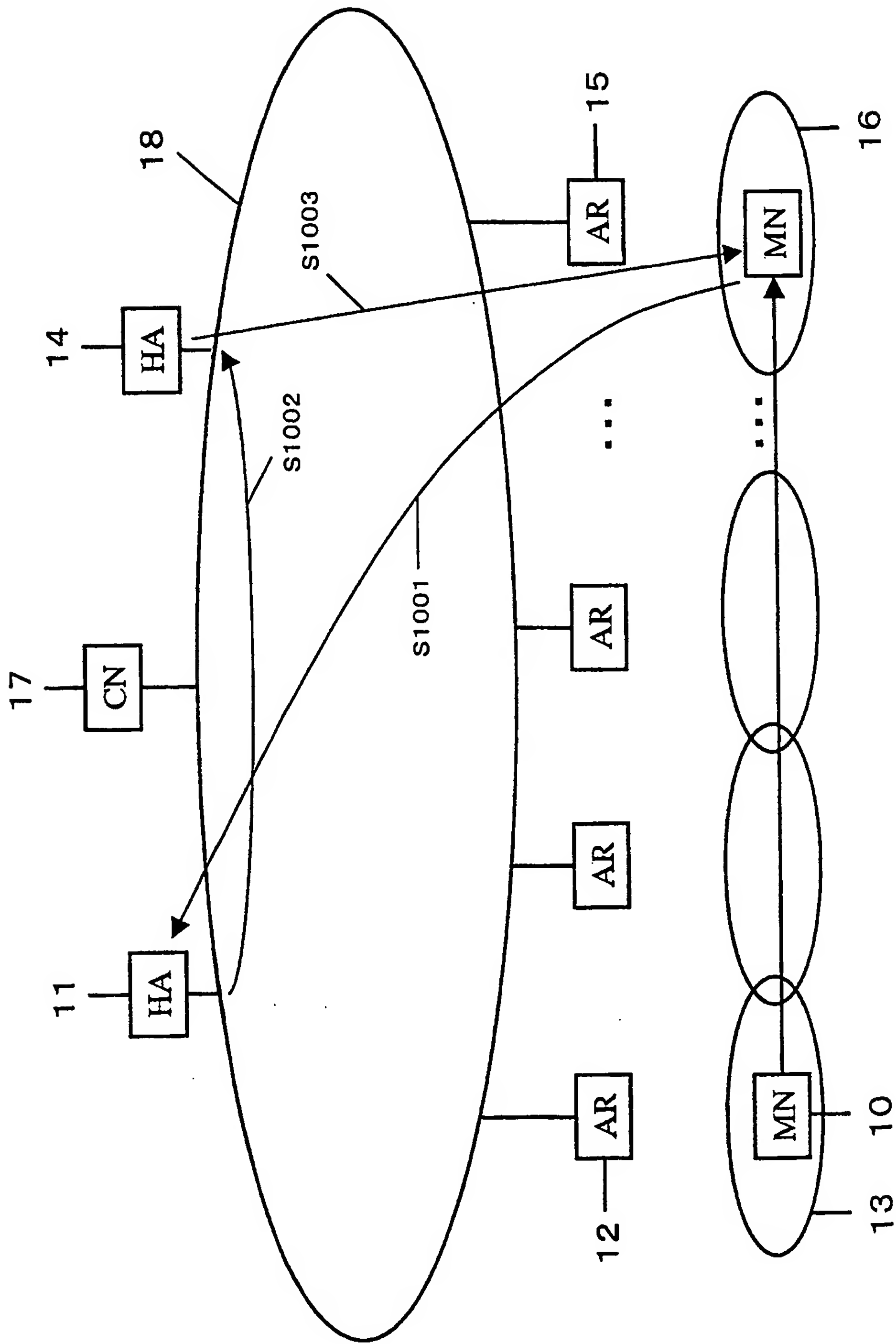


FIG. 17

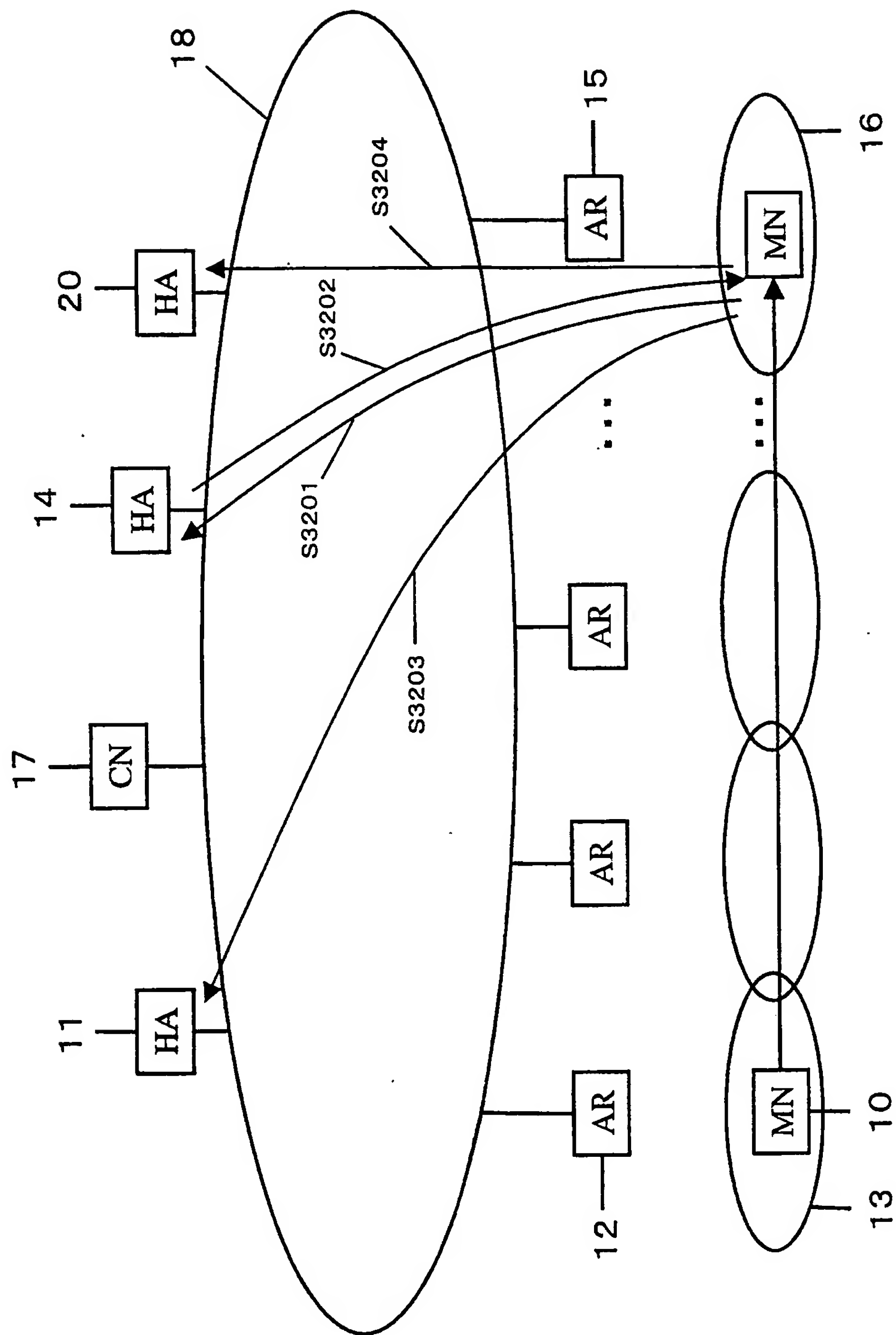


FIG. 18

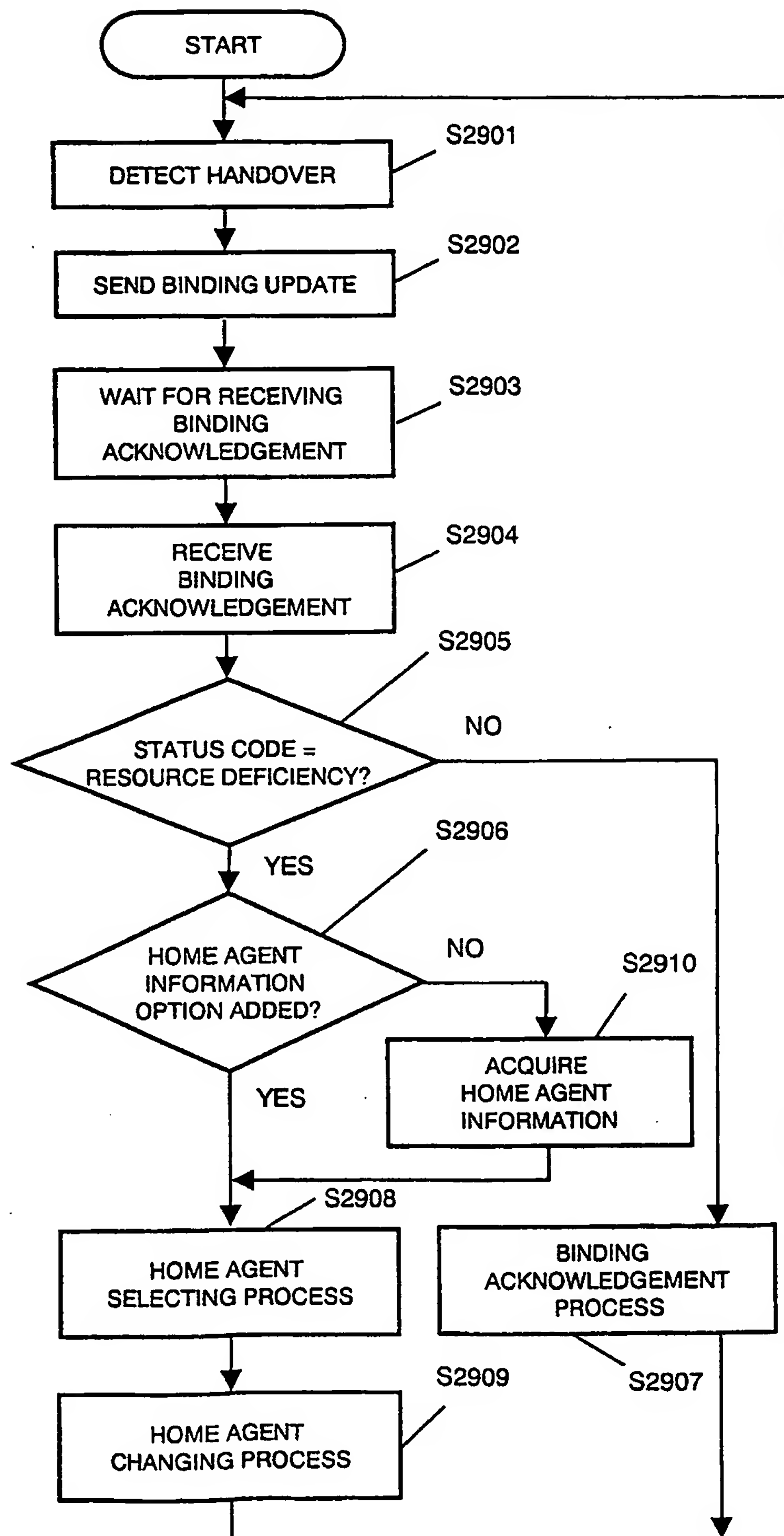
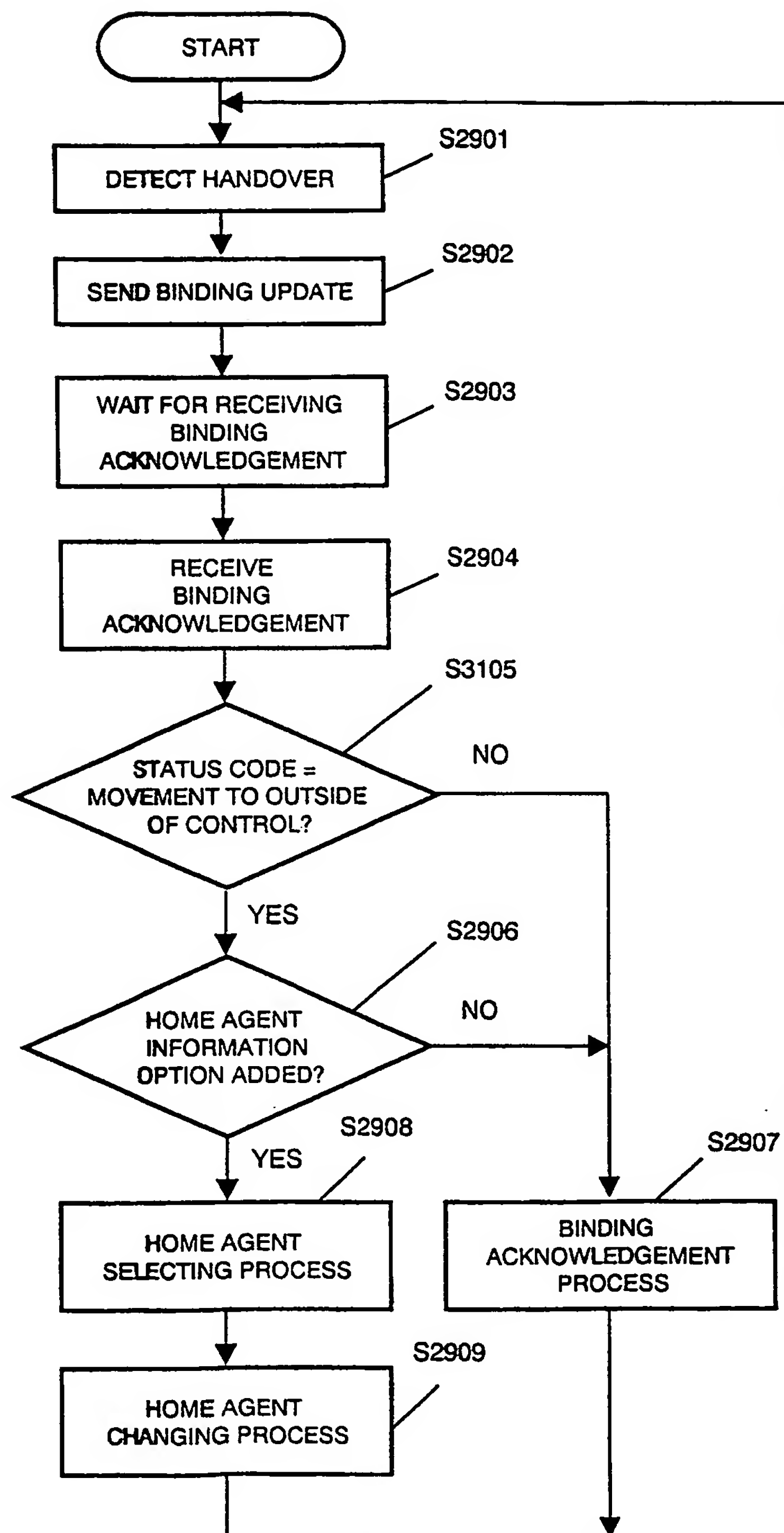
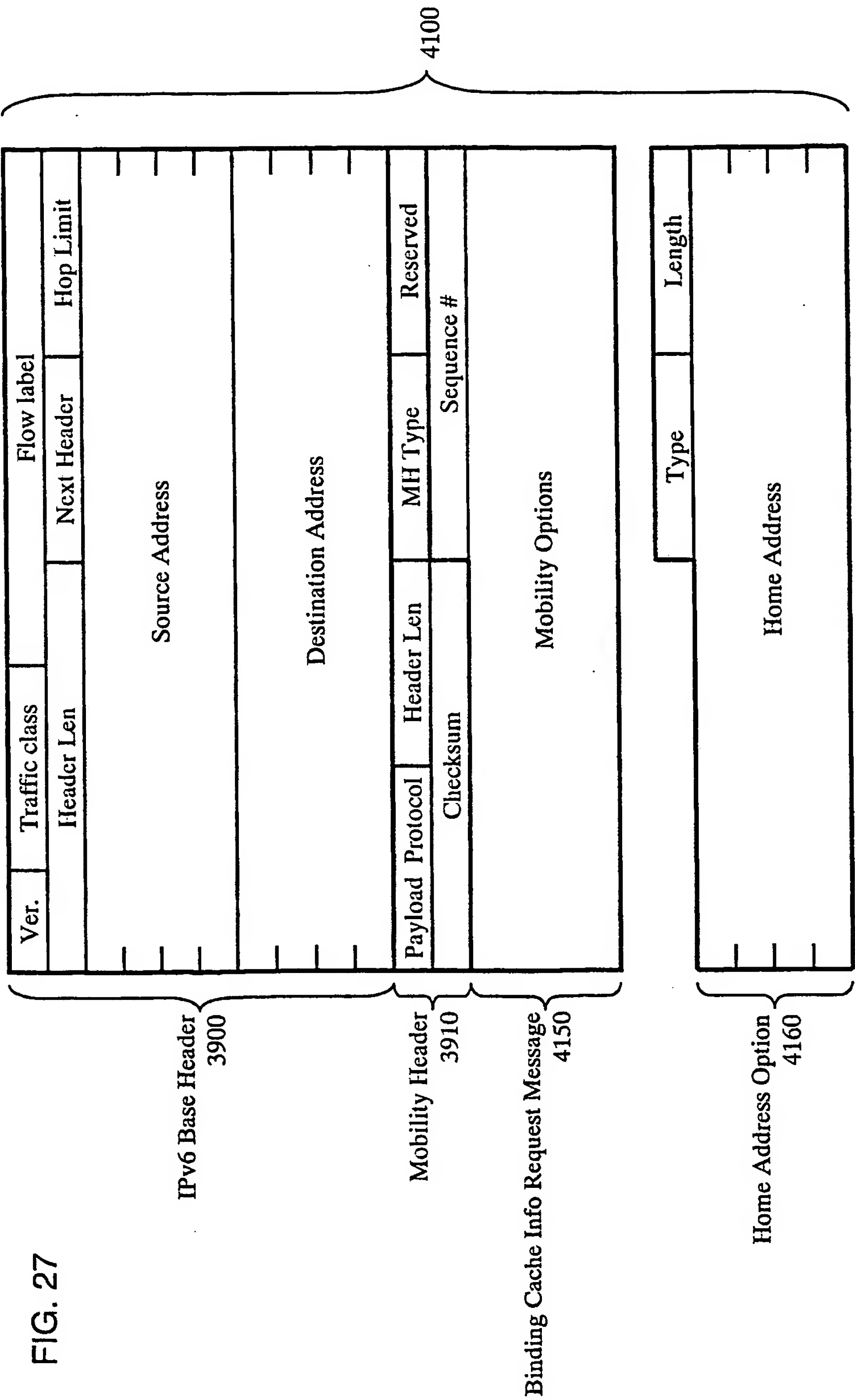
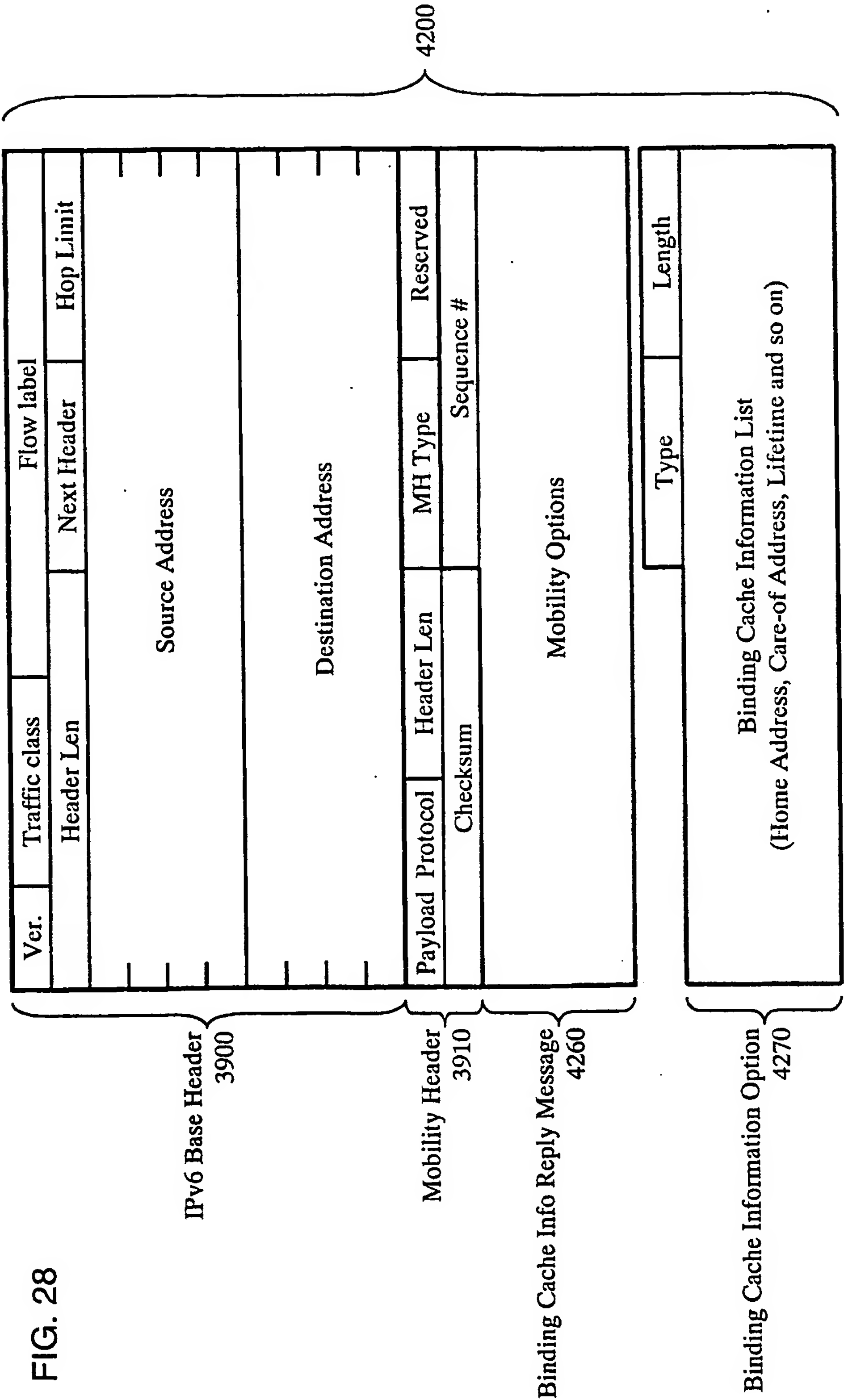
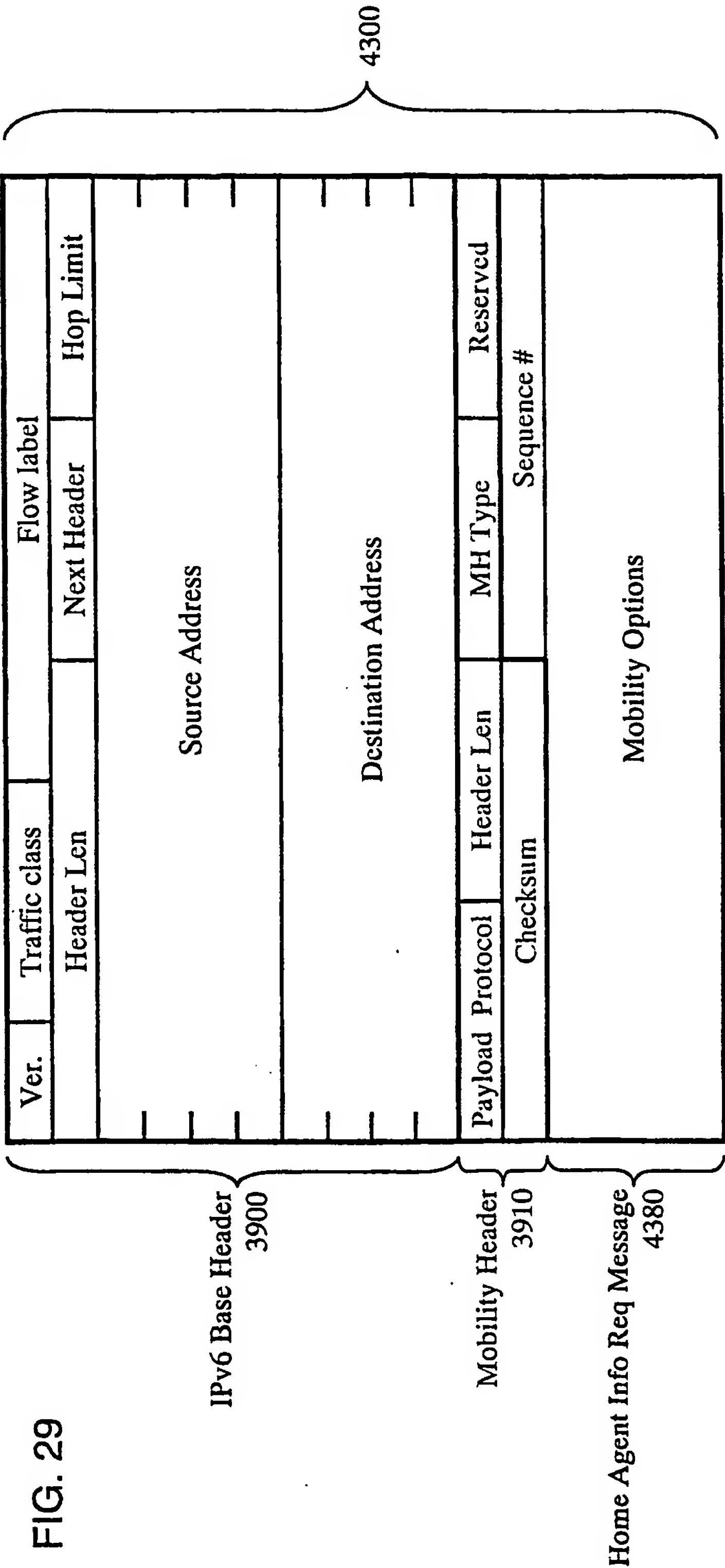


FIG. 19









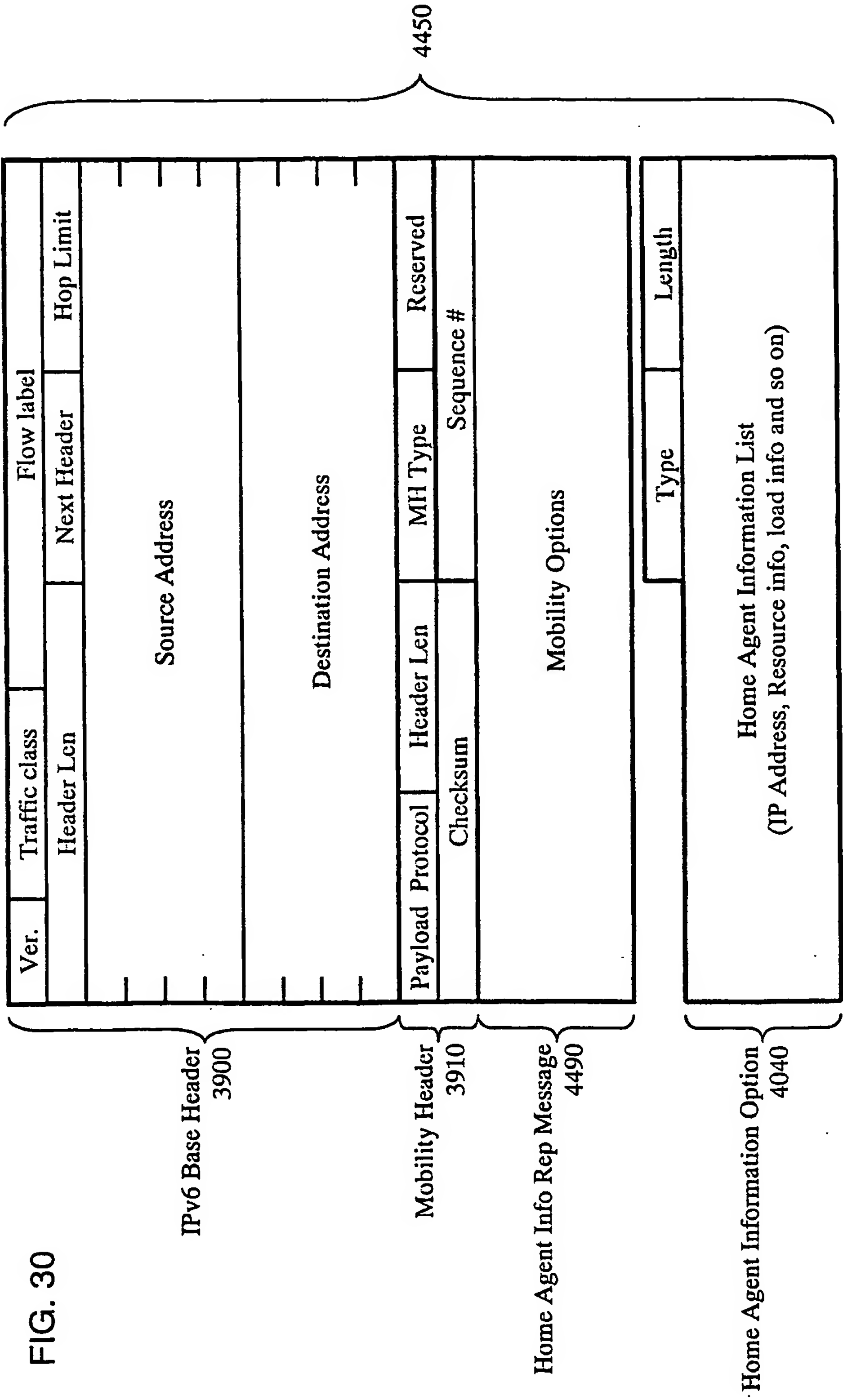
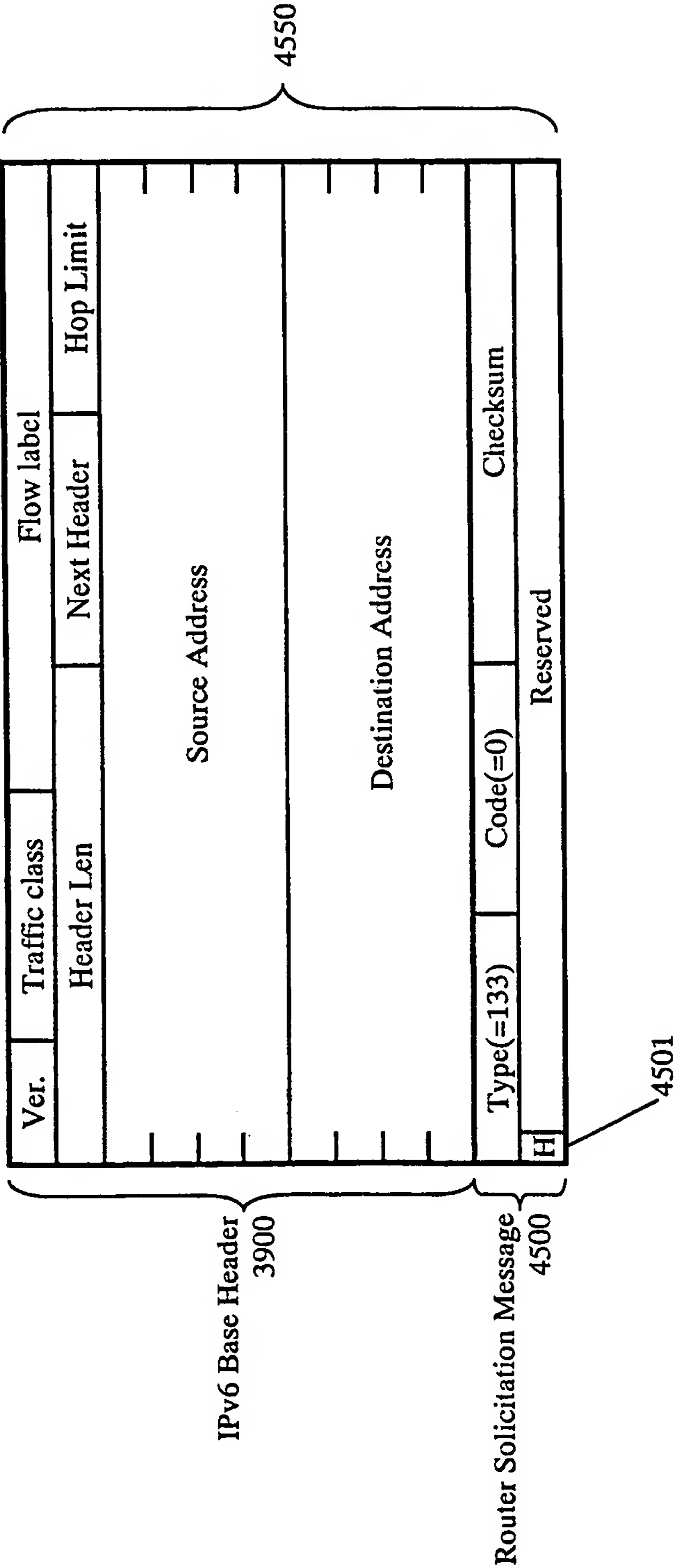


FIG. 31



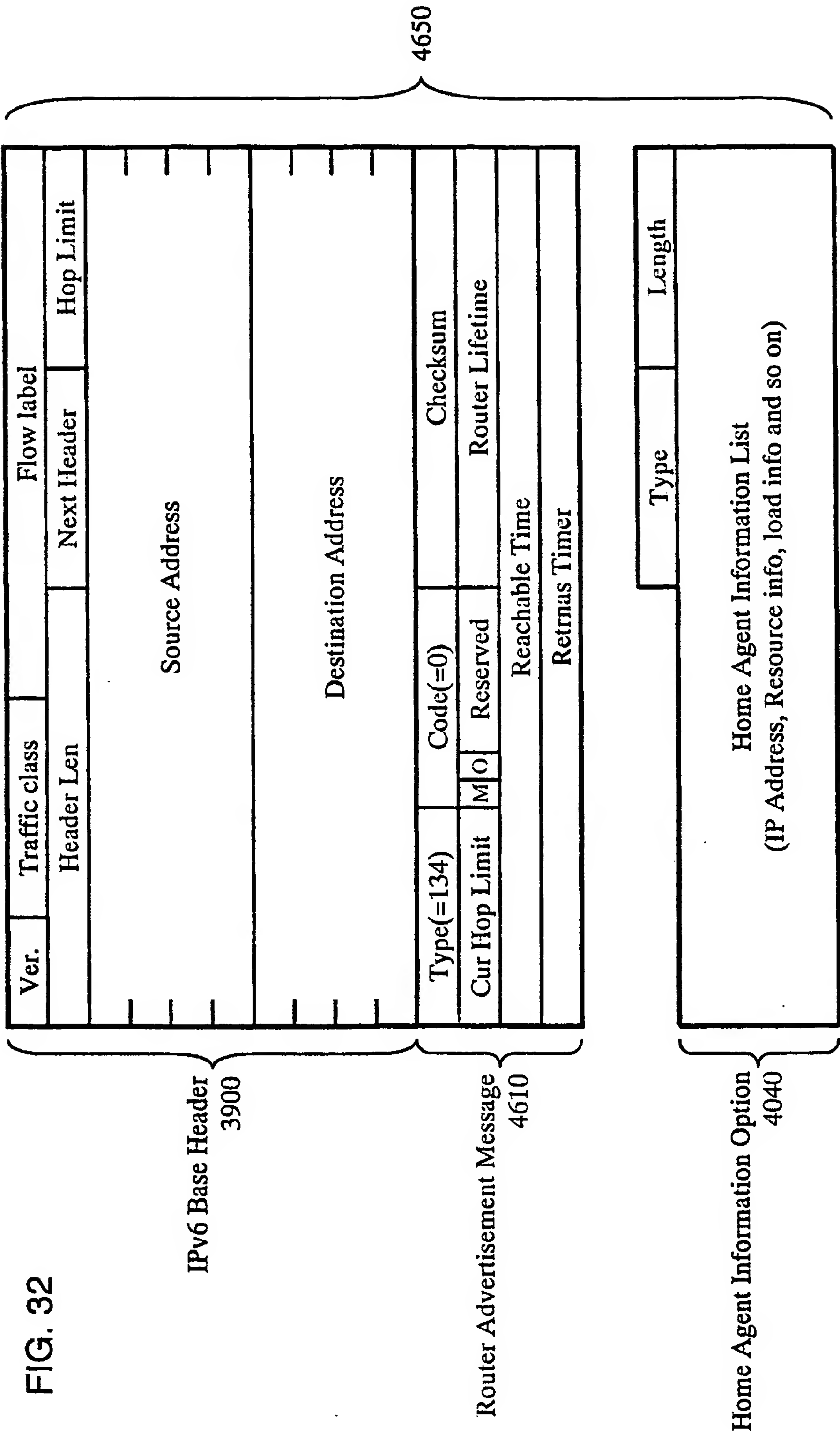
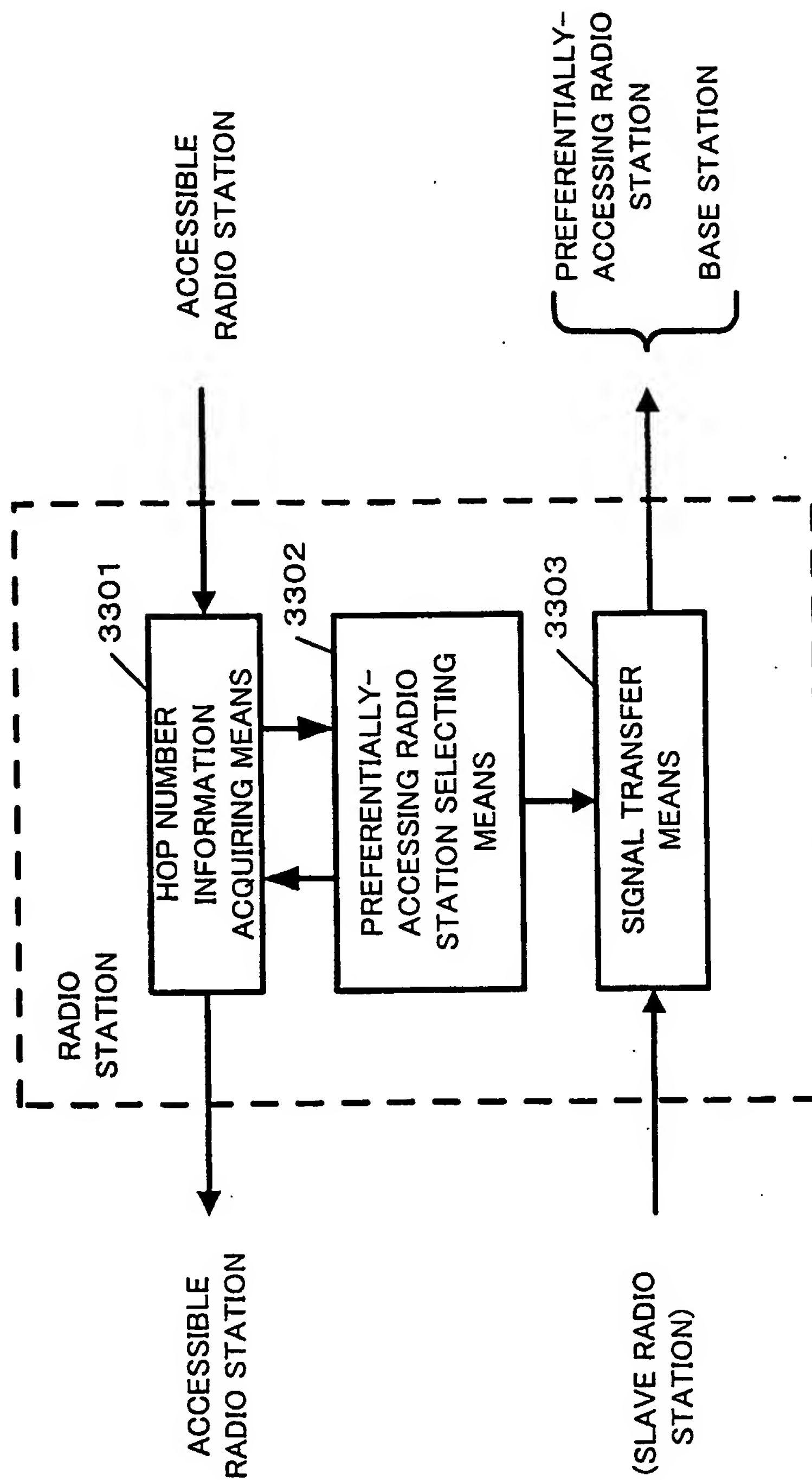


FIG.33



LIST OF DRAWING REFERENCE NUMBERS

10 MOBILE NODE

11,14,20 HOME AGENT

12,15 ACCESS ROUTER

13,16 RESPECTIVE RANGE

17 CORRESPONDENT NODE

18 IP NETWORK

19 HOME AGENT INFORMATION STORING SERVER

1100,1200 COMMUNICATING SECTION

1101,1201,1208,1301,1401 DATA LINK INTERFACE

1102,1202 IP PROCESSING SECTION

1103,1403 UPPER LAYER INTERFACE

1106,1205,1305 HOP NUMBER MEASURING SECTION

1104 HOME AGENT SELECTING SECTION

1108,1207 COMMUNICATION DELAY TIME MEASURING SECTION

1107,1206,1306,1406 HOME AGENT INFORMATION ACQUIRING SECTION

1105,1203,1303,1404 HOME AGENT INFORMATION STORING SECTION

1110,1407 APPLICATION SECTION

1204,1304,1405 HOME AGENT INFORMATION NOTIFYING SECTION

1210,1300,1400 NETWORK INTERFACE

1302,1402 IP PROCESSING SECTION

1307 COMMUNICATION DELAY TIME MEASURING SECTION

2508 HOP-NUMBER/COMMUNICATION-DELAY-TIME MEASURING SECTION

3301 HOP NUMBER INFORMATION ACQUIRING MEANS

3302 PREFERENTIALLY-ACCESSING RADIO STATION SELECTING MEANS